UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/533,625	04/11/2007	George W. Roberts	5051-663	1797

20792 7590 11/28/2007
MYERS BIGEL SIBLEY & SAJOVEC
PO BOX 37428
RALEIGH, NC 27627

EXAMINER	
CHOI, LING SIU	
ART UNIT	**PAPER NUMBER**
1796	

MAIL DATE	DELIVERY MODE
11/28/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/533,625	ROBERTS ET AL.	
	Examiner	Art Unit	
	Ling-Siu Choi	1796	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-26 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-26 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 03 May 2005 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 8/17/07, 5/3/05.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-26 are now pending, wherein claims 1-18 are drawn to a method to hydrogenate a polymer and claims 19-26 are drawn to a method to hydrogenate a polymer.

Claim Objections

2. Claims 1-18 are objected to because of the following informalities: (a) Claim 1, lines 5-6, "Nickel and Ruthenium" is suggested to be changed to --nickel and ruthenium--; (b) Claim 4, line 3, "molybdenum rhenium" is suggested to be changed to –molybdenum, rhenium--; and (c) Claim 19, lines 14-15, "to react said hydrogen with said polymer hydrogen and hydrogenate said polymer" is suggested to be changed to -- to react said hydrogen with said polymer and said polymer is hydrogenated--.

Appropriate correction is required.

Claim Analysis

3. Summary of claim 1:

A method of hydrogenating a polymer, comprising the steps of:	
A	providing a dense phase, the dense phase comprising a polymer in an organic solvent;
B	providing a catalyst system, the catalyst system comprising at least one metal hydrogenation catalyst selected from the group consisting of nickel and ruthenium immobilized on a solid support; and
C	providing a light phase, the light phase comprising hydrogen and carbon dioxide; and
D	contacting the dense phase, the light phase, and the catalyst system so that the hydrogen reacts with the polymer and the polymer is hydrogenated

Summary of claim 19:

A method of hydrogenating a polymer, comprising the steps of:	
A	providing a liquid dense phase, the dense phase consisting essentially of a polymer in an organic solvent: **the polymer** selected from the group consisting of polystyrene, poly(bisphenol A carbonate), poly(ethylene terephthalate), polybutadiene and copolymers thereof, and polyisoprene and copolymers thereof; **the solvent** included in the dense phase in an amount of from 0.1 to 20 wt%
B	providing a solid catalyst system, **the catalyst system** comprising at least one metal hydrogenation catalyst selected from the group consisting of nickel and ruthenium immobilized on a solid support; and
C	providing a **gas or supercritical** fluid a light phase, the light phase consisting essentially of hydrogen at a pressure of 100 to 2000 psi and carbon dioxide at a pressure of 100 to 3000 psi; and
D	contacting the dense phase, the light phase, and the catalyst system

	at a temperature of 50 to 300°C, and in an amount of 0.1 to 1 weight of catalyst system per weight of polymer, to react hydrogen with the polymer and the polymer is hydrogenated.

Claim Rejections - 35 USC § 103

4. **The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:**

> **(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.**

5. Claims 1-18 and 19-26 (for gas fluid a light phase) are rejected under 35 U.S.C. 103(a) as being unpatentable over Wage et al. (US 6,420,491 B1) in view of Zehner et al. (US 6,894,193 B2).

Wage et al. disclose a process to hydrogenate an aromatic polymer in (A) a solvent comprising (i) a hydrocarbon selected from at least one of a cycloaliphatic hydrocarbon and an aliphatic hydrocarbon and (ii) at least one oxygen-containing hydrocarbon in the presence of (b) a catalyst comprising (i) a support comprising at least one of silicon dioxide and aluminum oxide and (ii) at least one metal of sub-group VIII of the periodic table of the elements, wherein the aromatic polymer can be polystyrene and the metal of sub-group Viii of the periodic table of the elements is nickel

(col. 2, lines 58-59; col. 3, lines 30-42 and 65-67; col. 4, lines 1-7; col. 5, lines 53-55; claim 1).

The difference between the present claims and the disclosure of Zehner et al. is the requirement of a combination of hydrogen and carbon dioxide to be utilized in the present claims.

Zehner et al. disclose a process to hydrogenate liquid organic compounds in the presence of a mixture of the hydrogen used for the hydrogenation with proportions of at least one gas which is inert in the hydrogenation reaction to achieve an optimum mass transfer between the hydrogen and the hydrogenation bath takes place, which results in suppressing the aging of the catalyst and increasing the selectivity of the reaction, wherein the inert gas can be carbon dioxide (col. 2, lines 1-18 and 39-56). In view of such benefit, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a combination of hydrogen ans carbon dioxide in the disclosure of Wege et al. and thereby obtain the present invention.

6. Claims 1-18 and 19-26 (for gas fluid a light phase) are rejected under 35 U.S.C. 103(a) as being unpatentable over Hucul et al. (US 5,612,422) in view of Zehner et al. (US 6,894,193 B2).

Hucul et al. disclose a process to hydrogenate an aromatic polymer, comprising contacting the aromatic polymer with a hydrogenating agent in the presence of a silica supported metal hydrogenation catalyst at a temperature between about 50 to about 250°C such that at least 80 percent aromatic hydrogenation is achieved, wherein the

hydrogenating agent can be hydrogen; the metal can be nickel or ruthenium; and the aromatic polymer can be polystyrene (claims 1, 3-4, and 12-13)

The difference between the present claims and the disclosure of Hicul et al. is the requirement of a combination of hydrogen and carbon dioxide to be utilized in the present claims.

Zehner et al. disclose a process to hydrogenate liquid organic compounds in the presence of a mixture of the hydrogen used for the hydrogenation with proportions of at least one gas which is inert in the hydrogenation reaction to achieve an optimum mass transfer between the hydrogen and the hydrogenation bath takes place, which results in suppressing the aging of the catalyst and increasing the selectivity of the reaction, wherein the inert gas can be carbon dioxide (col. 2, lines 1-18 and 39-56). In view of such benefit, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a combination of hydrogen ans carbon dioxide in the disclosure of Hucul et al. and thereby obtain the present invention.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: Xu et al. [Southestern Catalysis Society (Spring Symposium), April 13-14, 2003], Ross et al. (GB 2 374 071 A), and Poliakoff et al. (WO 97/38955).

Xu et al. disclose a process to hydrogenate polystyrene in decahydro naphthalene in the presence of hydrogen and CO_2 under supercritical conditions, using

$Pd/BaSO_4$ as a catalyst, wherein the supercritical CO_2 reduces the viscosity of polymer solution to enhance hydrogen transport from the gas into the polystyrene solution (summary). However, the published date is later than the priority date.

Ross et al. disclose a continuous process to hydrogenate a substrate in the presence of a supercritical fluid, wherein the substrate is "alkene, alkyne, lactone...and ketal" and the supercritical fluid can be carbon dioxide (abstract; claims 1-4). However, Ross et al. do not teach or fairly suggest the claimed process to hydrogenate a polymer.

Poliakoff et al. disclose a process to hydrogenate an aliphatic or aromatic substrate under supercritical or near critical conditions, wherein the supercritical fluid can be carbon dioxide (claims 1 and 9). However, Poliakoff et al. do not teach or fairly suggest the claimed process to hydrogenate a polymer.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ling-Siu Choi whose telephone number is 571-272-1098.

If attempt to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Wu, can be reached on 571-272-1114.

LING-SUI CHOI
PRIMARY EXAMINER

November 20, 2007